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Antimony

UNITED STATES DEPARTMENT OF THE INTERIOR

The statistical data in this volume represents the most comprehensive, verified, domestic and international coverage for 1987 at the time the volume went to press. More recent information can be found in the quarterly Antimony Mineral Industry Surveys obtainable from Publications Distribution, Bureau of Mines, Box 18070, Cochrans Mill Road, Pittsburgh, PA 15236.

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UNITED STATES DEPARTMENT OF THE INTERIOR • Donald Paul Hodel, Secretary

BUREAU OF MINES • T S Ary, Director

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

Antimony

By Thomas O. Llewellyn[1]

The production of primary antimony products increased compared with that of 1986 as a result of increasing demand. Exports and imports of antimony materials were also up from those of the previous year. In November, the General Services Administration (GSA) completed the sale of antimony metal from the National Defense Stockpile (NDS) that was in excess of the goal. As the result of continued research, a new technique was developed to produce antimony trichloride and antimony trioxide using sulfide ores containing a high percentage of impurities.

Domestic Data Coverage.—Domestic production data for antimony are developed by the Bureau of Mines from two voluntary surveys of U.S. operations. Typical of these surveys is the "Primary Antimony" survey. Of the nine operations to which a survey request was sent, all responded, representing 100% of the primary smelter production shown in table 1 and 100% of the total antimony content of primary antimony production by class shown in table 3.

Table 1.—Salient antimony statistics

(Short tons of antimony content unless otherwise specified)

	1983	1984	1985	1986	1987
United States:					
Production:					
Primary:					
Mine (recoverable antimony)	838	557	W	W	
Smelter	14,557	17,639	16,449	17,978	20,704
Secondary	14,204	14,823	15,030	r15,522	16,647
Exports of metal, alloys, waste and scrap	304	511	362	595	876
Exports of antimony oxide	365	480	885	580	777
Imports for consumption	12,885	23,089	20,694	25,401	26,729
Reported industrial consumption, primary antimony	10,418	12,465	11,697	r10,952	11,086
Stocks: Primary antimony, all classes, Dec. 31	3,935	6,895	6,040	r6,131	6,835
Price: Average, cents per pound[1]	91.3	151.2	131.1	121.9	110.6
World: Mine production	55,881	60,309	62,367	p64,146	e61,875

eEstimated. pPreliminary. rRevised. W Withheld to avoid disclosing company proprietary data.
[1]New York dealer price for 99.5% to 99.6% metal, c.i.f. U.S. ports.

Legislation and Government Programs.—On January 7, 1987, pursuant to section 303(a)(2) of the Comprehensive Anti-Apartheid Act of 1986, as amended (Public Law 99-440), antimony was certified by the U.S. Department of State as a strategic mineral essential for the economy or defense of the United States that was unavailable in adequate quantities from reliable and secure suppliers.[2]

The Department of Defense Authorization Act, 1987 (Public Law 99-661), signed by the President on November 14, 1986, authorized the disposal of 1,500 short tons of antimony metal from the NDS. As a result of this authorization, the GSA continued the offering of excess antimony metal from the NDS as tender for its program to upgrade stockpile ferroalloys. The total sale of excess antimony metal under this program during calendar year 1987 was 1,381 tons. In November, GSA completed its latest sale of excess antimony metal from the NDS. Further sales of antimony from the stockpile will require new legislative authority.

GSA reported that Government stock of antimony metal in the NDS totaled 35,998 tons of stockpile-grade material at yearend. The national stockpile goal of 36,000 tons remained unchanged through 1987.

DOMESTIC PRODUCTION

Primary.—In 1987, antimony oxide production reached its highest level in over 30 years, owing to an increased demand for flame-retardant applications.

In December, Anzon America Inc., a U.S. subsidiary of the London-based Cookson Group, signed an agreement to purchase McGean-Rohco Inc.'s antimony oxide plant in Cleveland, OH, and McGean's interest in an antimony smelter in the Republic of South Africa.

The producers of primary antimony metal and oxide products were ASARCO Incorporated, Omaha, NE; Amspec Chemical Corp., Gloucester City, NJ; Anzon America, Laredo, TX; Chemet Co., Moscow, TN; Laurel Industries Inc., La Porte, TX; McGean Chemical Co. Inc., Cleveland, OH; M&T Chemicals Inc., Baltimore, MD; Sunshine Mining Co , Kellogg, ID; and U.S. Antimony Corp., Thompson Falls, MT.

Table 2.—Antimony mine production and shipments in the United States

(Short tons of recoverable antimony)

Year	Produced	Shipped
1983	838	878
1984	557	711
1985	W	W
1986	W	W
1987	--	--

W Withheld to avoid disclosing company proprietary data.

Table 3.—Primary antimony produced in the United States

(Short tons of antimony content)

Year	Class of material produced or generated				Total
	Metal	Oxide	Residues	Byproduct antimonial lead	
1983	1,121	13,153	283	W	14,557
1984	1,113	16,379	147	W	17,639
1985	943	15,398	108	W	16,449
1986	378	17,525	75	W	17,978
1987	W	20,677	27	W	20,704

W Withheld to avoid disclosing company proprietary data; not included in "Total."

Secondary.—Production of antimony from purchased scrap increased compared with that of 1986. Old scrap, predominantly lead battery plates containing antimony, was the source of most of the secondary material. New scrap, mostly drosses and residues from various sources, supplied the remainder. The antimony content of scrap was chiefly recovered and consumed as antimonial lead with removal or addition of antimony metal as required in the refining procedure to meet specifications for antimonial lead alloys.

Table 4.—Secondary antimony produced in the United States, by kind of scrap and form of recovery

(Short tons of antimony content unless otherwise specified)

	1986[r]	1987
KIND OF SCRAP		
New scrap: Lead- and tin-base	1,366	1,435
Old scrap: Lead- and tin-base	14,156	15,212
Total	15,522	16,647
FORM OF RECOVERY		
In antimonial lead	14,776	15,943
In other lead- and tin-base alloys	746	704
Total	15,522	16,647
Value (millions)	$41	$44

[r]Revised.

CONSUMPTION AND USES

Antimony compounds were used in plastics both as stabilizers and as flame retardants. Antimony trioxide in an organic solvent was used to make textiles, plastics, and other combustible flame retardants. Antimony was used as a decolorizing and refining agent in some forms of glass, such as special optical glass. The largest end use for antimony compounds was in flame retardants.

Lead-antimony alloys were used in starting-lighting-ignition (SLI) batteries, ammunition, corrosion resistant pumps and pipes, tank linings, roofing sheets, solder, cable sheaths, and antifriction bearings. In 1987, the Battery Council International reported that the total domestic shipments of replacement and original equipment of SLI batteries for automotives remained at the same level as that of 1986.

Table 5.—Reported industrial consumption of primary antimony in the United States

(Short tons of antimony content)

Year	Class of material consumed					Total
	Metal	Oxide	Sulfide	Residues	Byproduct antimonial lead	
1983	1,245	8,867	23	283	W	10,418
1984	1,543	10,747	28	147	W	12,465
1985	1,503	10,053	33	108	W	11,697
1986	r2,437	8,410	30	75	W	r10,952
1987	2,194	8,799	66	27	W	11,086

rRevised. W Withheld to avoid disclosing company proprietary data; not included in "Total."

Table 6.—Reported industrial consumption of primary antimony in the United States, by product

(Short tons of antimony content)

Product	1983	1984	1985	1986r	1987
Metal products:					
Ammunition	175	W	410	W	W
Antimonial lead	926	845	568	607	732
Bearing metal and bearings	143	182	177	153	206
Cable covering	31	W	W	68	W
Castings	9	11	11	12	9
Collapsible tubes and foil	W	W	W	W	W
Sheet and pipe	43	80	W	40	84
Solder	154	232	336	278	383
Type metal	10	31	31	9	9
Other	71	337	105	418	827
Total	1,562	1,718	1,638	1,585	2,250
Nonmetal products:					
Ammunition primers	16	21	27	23	58
Ceramics and glass	1,252	1,292	1,187	1,027	1,237
Fireworks	4	7	4	4	3
Pigments	198	178	147	250	307
Plastics	993	1,108	998	975	827
Rubber products	70	21	25	41	W
Other	119	161	141	162	220
Total	2,652	2,788	2,529	2,482	2,652
Flame-retardant:					
Adhesives	184	343	310	170	347
Paper	133	159	111	1	W
Pigments	14	8	8	14	33
Plastics	4,441	5,858	5,529	4,979	4,490
Rubber	220	342	315	439	426
Textiles	1,212	1,249	1,257	1,282	882
Other	--	--	--	--	6
Total	6,204	7,959	7,530	6,885	6,184
Grand total	10,418	12,465	11,697	10,952	11,086

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other."

Table 7.—Industry stocks of primary antimony in the United States, December 31

(Short tons of antimony content)

Stocks	1983	1984	1985	1986	1987
Antimonial lead[1]	W	W	W	W	W
Metal	805	582	807	r957	954
Ore and concentrate	446	1,304	1,164	1,030	1,265
Oxide	2,614	4,926	3,954	4,019	4,499
Residues and slags	51	69	99	106	92
Sulfide	19	14	16	19	25
Total	3,935	6,895	6,040	r6,131	6,835

rRevised. W Withheld to avoid disclosing company proprietary data; not included in "Total."
[1]Inventories from primary sources at primary lead refineries only.

PRICES

The New York dealer price range for antimony metal, published by Metals Week, began 1987 at $1.05 to $1.10 per pound. The price range showed minor fluctuations throughout the year, and by yearend was $1.12 to $1.16 per pound.

Asarco's published price for high-tint antimony trioxide in lots of 40,000 pounds was $1.25 per pound at the beginning of the year. This price was increased to $1.30 at the end of April, held steady until November 5, when it was raised to $1.35 per pound, and remained constant for the rest of 1987.

European price quotations for antimony ore and concentrates, published by the Metal Bulletin (London), held steady during the first 4 months of the year, and followed an upward trend for the rest of 1987. At yearend, the published price range quotations were as follows: clean sulfide concentrates, 60% antimony content, $21.50 to $23.00 per metric ton unit (equivalent to $19.50 to $20.85 per short ton unit); and lump sulfide ore, 60% antimony content, $23.00 to $25.00 per metric ton unit (equivalent to $21.30 to $22.70 per short ton unit).

Table 8.—Antimony price ranges in 1987, by type

Type	Price per pound
Domestic metal[1]	$2.00
Foreign metal[2]	$1.05- 1.16
Antimony trioxide[3]	1.25- 1.35

[1]Based on antimony in alloy.
[2]Duty-paid delivery, New York.
[3]Producer price, published by ASARCO Incorporated, for high-tint antimony trioxide.

FOREIGN TRADE

The United States also exported 1,479 tons (gross weight) of other antimony compounds with a value of 4.6 million. The Federal Republic of Germany, the Republic of Korea, Mexico, and the United Kingdom were the recipients of approximately 70% of these exports, and the remainder was distributed among 24 other countries.

China, Hong Kong, Mexico, and the Republic of South Africa, supplied over 72% of the materials imported into the United States during 1987. China was the principal supplying country of antimony to the United States for the last 4 years and was expected to continue in that position because it has displaced the other two principal antimony suppliers, Bolivia and the Republic of South Africa.

Table 9.—U.S. exports of antimony metal, alloys, waste and scrap, by country

Country	1986		1987	
	Gross weight (short tons)	Value (thousands)	Gross weight (short tons)	Value (thousands)
Belgium-Luxembourg	--	--	45	$390
Canada	28	$83	199	863
Dominican Republic	--	--	16	39
Germany, Federal Republic of	26	41	46	117
Italy	1	30	1	6
Japan	130	278	43	68

Table 9.—U.S. exports of antimony metal, alloys, waste and scrap, by country —Continued

Country	1986		1987	
	Gross weight (short tons)	Value (thousands)	Gross weight (short tons)	Value (thousands)
Korea, Republic of	10	$15	4	$6
Mexico	29	49	61	109
Netherlands	14	24	52	390
Saudi Arabia	191	147	--	--
Spain	44	103	110	90
Taiwan	1	3	(1)	9
Trinidad	13	49	--	--
United Kingdom	31	84	81	154
Venezuela	30	68	124	224
Other	46	237	94	352
Total[2]	595	1,210	876	2,817

[1]Less than 1/2 unit.
[2]Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

Table 10.—U.S. exports of antimony oxide, by country

Country	1986			1987		
	Gross weight (short tons)	Antimony content[1] (short tons)	Value (thousands)	Gross weight (short tons)	Antimony content[1] (short tons)	Value (thousands)
Australia	2	2	$9	--	--	--
Belgium-Luxembourg	14	12	53	22	18	$76
Brazil	--	--	--	16	13	62
Canada	319	265	916	395	328	1,141
Costa Rica	--	--	--	23	19	34
Germany, Federal Republic of	48	40	146	52	43	165
India	13	11	56	15	12	50
Israel	--	--	--	11	9	21
Italy	111	92	423	99	82	360
Japan	10	8	25	53	44	167
Korea, Republic of	43	36	95	31	26	90
Mexico	42	35	117	48	40	82
Singapore	12	10	41	28	23	79
Taiwan	18	15	65	23	19	63
Turkey	23	19	74	55	46	169
United Kingdom	10	8	29	35	29	83
Uruguay	12	10	38	--	--	--
Venezuela	3	2	15	8	7	39
Other	17	15	79	22	19	71
Total[2]	699	580	2,182	936	777	2,752

[1]Estimated by the Bureau of Mines.
[2]Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

Table 11.—U.S. imports for consumption of antimony, by class and country

Class and country	1986			1987		
	Gross weight (short tons)	Antimony content[1] (short tons)	Value (thousands)	Gross weight (short tons)	Antimony content[1] (short tons)	Value (thousands)
Antimony ore and concentrate:						
Bangladesh	--	--	--	66	43	$61
Bolivia	741	470	$661	1,329	825	1,182
Canada	1	(2)	1	--	--	--
Chile	65	39	40	66	43	60
China	1,450	886	1,088	2,167	1,269	1,558
Guatemala	1,094	616	726	2,436	1,379	718
Guyana	56	33	32	--	--	--
Honduras	66	26	19	100	45	34
Hong Kong	850	387	484	513	302	362
Korea, Republic of	19	11	40	--	--	--

See footnotes at end of table.

Table 11.—U.S. imports for consumption of antimony, by class and country —Continued

Class and country	1986			1987		
	Gross weight (short tons)	Antimony content[1] (short tons)	Value (thousands)	Gross weight (short tons)	Antimony content[1] (short tons)	Value (thousands)
Antimony ore and concentrate — Continued						
Mexico	5,541	2,913	$2,255	3,772	1,308	$1,312
Peru	70	40	56	120	69	75
South Africa, Republic of	19	16	7	--	--	--
Thailand	779	366	386	745	307	343
Trindad	--	--	--	22	12	12
United Kingdom	83	53	96	53	32	15
Total[3]	10,833	5,855	5,892	11,389	5,634	5,732
Antimony oxide:						
Belgium-Luxembourg	472	392	1,243	807	670	1,853
Bolivia	833	691	1,315	546	453	918
Chile	221	183	333	--	--	--
China	3,410	2,830	7,818	3,404	2,825	6,653
France	881	731	2,463	883	733	2,206
Germany, Federal Republic of	101	84	703	96	80	731
Guatemala	--	--	--	75	62	70
Hong Kong	1,155	959	2,566	1,103	915	2,321
Japan	1	1	14	3	2	37
Mexico	27	22	28	460	382	408
Netherlands	38	32	92	--	--	--
South Africa, Republic of	5,889	4,888	3,884	4,332	3,596	2,986
Spain	56	46	138	--	--	--
Taiwan	195	162	365	187	155	372
United Kingdom	241	200	567	159	132	411
Yugoslavia	--	--	--	1,590	1,320	1,058
Total[3]	13,521	11,221	21,529	13,645	11,325	20,024
Antimony sulfide:[4]						
Austria	4	3	15	7	5	24
Belgium-Luxembourg	--	--	--	9	6	18
China	538	360	565	86	58	70
Hong Kong	20	13	8	--	--	--
Mexico	13	9	9	--	--	--
Total[3]	576	385	596	102	69	112

[1]Antimony ore and concentrate content reported by Bureau of the Census. Antimony oxide and antimony sulfide content estimated by the Bureau of Mines.
[2]Less than 1/2 unit.
[3]Data may not add to totals shown because of independent rounding.
[4]Includes needle or liquated.

Source: Bureau of the Census.

Table 12.—U.S. imports for consumption of antimony metal, by country

Country	1986		1987	
	Gross weight (short tons)	Value (thousands)	Gross weight (short tons)	Value (thousands)
Belgium-Luxembourg	--	--	5	$4
Bolivia	127	$229	43	83
Canada	(1)	109	1	171
Chile	65	117	106	202
China	4,634	9,828	6,883	13,416
Germany, Federal Republic of	20	107	3	88
Hong Kong	1,232	2,810	1,184	2,268
Indonesia	--	--	66	409
Japan	(1)	1	--	--
Korea, Republic of	154	403	168	356
Mexico	1,359	896	990	669
Netherlands	20	51	(1)	9
Peru	11	24	--	--
Taiwan	--	--	19	30
Thailand	58	117	--	--
U.S.S.R.	236	502	189	383
United Kingdom	22	47	44	83
Total[2]	7,940	15,242	9,701	18,171

[1]Less than 1/2 unit.
[2]Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

WORLD REVIEW

Argentina.—An antimony deposit with possible reserves of about 0.5 million tons of ore was discovered in the Province of La Rioja. The provincial authorities were in the process of financing the exploration and development of the deposit, which could meet future domestic demand of antimony metal.

Mexico.—Anzon America and Cía. Minera y Refinadora Mexicana S.A. completed the installation and construction of a new concentration plant for low-grade ore at their mine in Wadley. The company expected to have the plant operating by early 1988, which would increase capacity by 1,100 tons per year.

South Africa, Republic of.—Consolidated Murchison Ltd., the Republic of South Africa's only antimony producer, raised funds to finance projects to explore areas where both gold and antimony mineralization had been known to exist and to deepen the Monarch East shaft to gain access to additional antimony reserves. Shaft sinking at the Monarch East area was completed, and the antimony ore mined contained a higher gold content.

United Kingdom.—Sassoon Metals and Chemicals AG formed a joint venture with China's Guangdong Metals and Minerals to market mineral commodities. The new trading company, China Industrial Resources (CIR), would buy and sell antimony, bismuth, copper, zinc, and other minerals worldwide. It was reported that CIR would be staffed by Chinese and Europeans with headquarters in London.[3]

U.S.S.R.—The Anzob antimony-mercury mining and beneficiation operation, in the Soviet Central Asian Republic of Tadzhikistan, was planning to increase production. The 5-year plan (1986-90) called for a plant-capacity expansion, which when completed would result in an antimony production increase of about 11% and a mercury production increase of 15%.

Table 13.—Antimony: World mine production (content of ore unless otherwise specified), by country[1]

(Short tons)

Country	1983	1984	1985	1986[p]	1987[e]
Australia[2]	593	1,267	2,317	991	1,100
Austria	726	577	526	566	580
Bolivia	10,969	10,231	9,838	11,291	9,000
Canada[3]	--	610	1,185	4,194	3,900
China[e]	16,500	16,500	16,500	16,500	16,500
Czechoslovakia	990	1,100	[e]1,100	[e]1,000	1,100
France	122	--	--	--	--
Guatemala	--	[e]100	1,165	2,092	2,100
Honduras[e]	--	120	100	110	110
Italy	--	269	546	336	330
Malaysia (Sarawak)	148	19	13	(4)	--
Mexico[5]	2,777	3,377	4,702	3,678	3,300
Morocco (content of concentrates)	500	1,071	[e]830	680	720
Pakistan	--	1	4	--	11
Peru (recoverable)	786	741	655	[e]740	720
South Africa, Republic of (content of concentrates)	6,947	8,201	8,150	7,513	7,500
Spain	539	643	273	[e]220	220
Thailand	1,315	2,172	1,367	1,123	1,400
Turkey	926	1,121	1,082	1,039	[e]1,104
U.S.S.R.[e]	10,000	10,300	10,400	10,500	10,600
United States[7]	838	557	W	W	--
Yugoslavia[e]	1,047	1,050	1,400	[r]1,380	1,390
Zimbabwe (content of concentrates)	158	282	214	193	190
Total	55,881	60,309	62,367	64,146	61,875

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]Table includes data available through May 27, 1988.
[2]Antimony content of antimony ore and concentrates, lead concentrates, and lead-zinc concentrates.
[3]Partly estimated on the basis of reported value of total production.
[4]Revised to zero.
[5]Antimony content of ores for export plus antimony content of antimonial lead and other smelter products produced.
[6]Reported figure.
[7]Production from antimony mines; excludes amount produced as a byproduct of domestic lead ores.

TECHNOLOGY

Preussag AG, Erdol und Chemie, Federal Republic of Germany, announced the development of a new process for producing antimony trichloride and antimony trioxide from sulfide ores that previously were not treated because of their high percentage of impurities. In the new technique, the finely ground ore was reacted with gaseous hydrogen chloride in a salt melt to remove the sulfur in the form of hydrogen sulfide. Antimony trichloride was recovered from the reaction mixture by distillation. The antimony trichloride was hydrolyzed to produce antimony trioxide. Preussag claimed to have successfully tested the new technique on a pilot plant scale, and that its main advantages were cost effectiveness, limited environmental impact, and a high-purity final product.[4]

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[1]Physical scientist, Branch of Nonferrous Metals.
[2]Federal Register. Strategic Minerals Listing. V. 52, No. 28, Feb. 11, 1987, p. 4454.
[3]Metals Week. Chinese, Sassoon Set Up Trading Unit. V. 58, No. 52, Dec. 28, 1987, p. 6.
[4]Engineering and Mining Journal. Preussag Process Produces Antimony Trioxide From Multi-Metal Sulphides. V. 188, No. 2, Feb. 1987, p. 55.

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